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Kiyoshi ARITA, et al.

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Sir,

I, Shu SUGITA, hereby declare that I am conversant with both English and Japanese languages, and certify to best of my knowledge and belief that the attached are true and correct English translation of Japanese Patent Application No. 2003-278076 filed on July 23, 2003.

Shu Sugita

Shu SUGITA

Date: October 23, 2009

PATENT OFFICE

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This is to certify that the annexed is a true copy of the following application as filed with this office.

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[Article]	Claims	1 copy
[Article]	Specification	1 copy
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[Designation Of Document] Claims

[Claim 1]

A plasma processing apparatus, which performs a plasma process for the reverse face of a wafer for which an insulating sheet is adhered to the obverse face and which, for the plasma process, handles at least two wafers, a large wafer and a small wafer, comprising:

an integrally formed electrode member, which is located in a process chamber that defines a closed space and which has a mounting face larger than a large wafer so that a wafer can be mounted while the insulating sheet is contacting the mounting face;

a pressure reduction unit, for discharging a gas from the closed space to reduce pressure;

a gas supply unit, for supplying a plasma generation gas to the closed space in which the pressure has been reduced;

an opposing electrode, positioned opposite the electrode member;

a plasma generator, for applying a high frequency voltage between the electrode member and the opposing electrode to set the plasma generation gas into a plasma state;

a DC voltage application unit, for applying a DC voltage to the electrode member to electrostatically attract the wafer positioned on the mounting face; and

a cooling unit for cooling the electrode member,

wherein the mounting face of the electrode member is divided into

a first area, which is located in the center of the mounting face, wherein a metal, the material used for the electrode member, is exposed,

a first insulating area, the surface of which is covered with an insulating film, that encloses, like a ring, the outer edge of the first area,

a second area, wherein the metal is exposed, that is extended, like a ring, around the outer edge of the first insulating area, and

a second insulating area, the surface of which is covered with an insulating film, that encloses, like a ring, the outer edge of the second area,

wherein a boundary between the first area and the first insulating area is designated inside the outer edge of a small wafer positioned in the center of the mounting face, and a boundary between the first insulating area and the second area is designated outside the outer edge of the small wafer,

wherein a boundary between the second area and the second insulating area is designated inside the outer edge of a large wafer positioned in the center of the mounting face, and the second insulating area extends outward from the large wafer, and

wherein a cover member, which has a ring shape and which is detachable from the mounting face, is provided to completely cover the second area.

[Claim 2]

A plasma processing apparatus according to claim 1, wherein the cover member is attached to the mounting face when a small wafer is to be processed, or is removed from the mounting face when a large wafer is to be processed.

[Claim 3]

A plasma processing apparatus according to claim 1, wherein the cover member is made of ceramic.

[Claim 4]

A plasma processing apparatus according to claim 1, wherein the insulating film covering the first insulating area and the insulating film covering the second insulating area are made of aluminous ceramic.

[Claim 5]

A plasma processing apparatus according to claim 2, further comprising:

a plurality of suction holes formed in the first area and the second area;

a vacuum suction unit for creating a vacuum and producing suction that, through the suction holes, draws the wafer to and holds the wafer on the mounting face; and

a blocking member, having a ring shape, that is attached to the second area, when the cover member is mounted on the mounting face, to block the plurality of suction holes in the second area,

wherein the cover member completely covers the blocking member.

[Claim 6]

A plasma processing apparatus according to claim 5, wherein the blocking member is formed by adhering, to one face of a ring-shaped plate made of the same material as the wafer, an insulating sheet made of the same material as the insulating sheet that is adhered to the wafer.

JP 2003-278076 filed on July 23, 2003

[Designation Of Document] Specification

[Title Of The Invention]

PLASMA PROCESSING APPARATUS

[Technical Field To Which The Invention Belongs]

[0001]

The present invention relates to a plasma processing apparatus that performs a plasma process for a wafer.

[0002]

[Background Art]

Since the thicknesses of semiconductor devices tend to be reduced, during a procedure employed in the manufacture of wafers for these devices, a thickness reduction process is performed to reduce the thicknesses of substrates. As part of this thickness reduction process, a circuit pattern is formed on one surface of a silicon substrate and the opposite face is mechanically ground. Following the grinding, a plasma process is used to remove a damaged layer, using etching, from the face of the silicon substrate for which the machine grinding was performed.

[0003]

Since wafers come in a variety of sizes, it is desirable that a single plasma processing apparatus for performing such a wafer plasma process be capable of handling wafers having different sizes. Consequently, presently well known plasma processing apparatuses were developed for which part or all of an electrode whereon a wafer is positioned can be replaced, depending on the size of the wafer that is to be processed (see, for example, patent documents 1 and 2). According to the example in patent document 1, an electrode is composed of a plurality of layers, and only the topmost layer, on which a wafer to be processed is positioned, is replaced. According to the example in patent document 2, an entire electrode member, through which cooling water channels are formed, is replaced.

[Patent Document 1] JP-A-10-223725

[Patent Document 2] JP-A-2001-210622

[Disclosure Of The Invention]

[Problems That The Invention Is To Solve]

[0004]

However, the plasma processing apparatuses disclosed in these conventional examples have the following problems. First, during the plasma process, an electrode must be appropriately cooled in order to prevent an excessive rise in the temperature of the electrode or of a wafer that is heated by plasma. However, since according to the example in patent document 1 an electrode is divided into layers, thermal transmission is blocked at the joint where the portion of an electrode that is replaced contacts the portion that is not replaced, and a reduction in the cooling efficiency can not be avoided.

[0005]

According to the example in patent document 2, since an expensive electrode member must be fabricated that corresponds in size to a wafer, an increase in unit costs can not be avoided. In addition, since the space available for the removal and mounting of electrode members is limited, the work efficiency for the replacement of an electrode is low; excessive labor and time are required. Furthermore, during a replacement operation, cooling water retained in an electrode tends to leak into a processing chamber, which is a frequent cause of contamination. As is described above, conventionally, it is difficult to easily and inexpensively process a plurality of wafers having different sizes using a single plasma processing apparatus.

[0006]

It is, therefore, one objective of the present invention to provide a plasma processing apparatus, a single unit, that can easily and inexpensively process a plurality of wafers having different sizes.

[Means For Solving The Problems]

[0007]

To achieve this objective, a plasma processing apparatus according to the present invention, which performs a plasma process for the reverse face of a wafer for which an insulating sheet is adhered to the obverse face and which, for the plasma process, can handle at least two wafers, a large wafer and a small wafer, comprises:

an integrally formed electrode member, which is located in a process chamber that defines a closed space and which has a mounting face larger than a large wafer so that a wafer can be mounted while the insulating sheet is contacting the mounting face;

a pressure reduction unit, for discharging a gas from the closed space to reduce pressure;

a gas supply unit, for supplying a plasma generation gas to the closed space in which the pressure has been reduced;

an opposing electrode, positioned opposite the electrode member;

a plasma generator, for applying a high frequency voltage between the electrode member and the opposing electrode to set the plasma generation gas into a plasma state;

a DC voltage application unit, for applying a DC voltage to the electrode member to electrostatically attract the wafer positioned on the mounting face; and

a cooling unit for cooling the electrode member,

wherein the mounting face of the electrode member is divided into

a first area, which is located in the center of the mounting face, wherein a metal, the material used for the electrode member, is exposed,

a first insulating area, the surface of which is covered with an insulating film, that encloses, like a ring, the outer edge of the first area,

a second area, wherein the metal is exposed, that is extended, like a ring, around the outer edge of the first insulating area, and

a second insulating area, the surface of which is covered with an insulating film, that encloses, like a ring, the outer edge of the second area,

wherein a boundary between the first area and the first insulating area is designated inside the outer edge of a small wafer positioned in the center of the mounting face, and a boundary between the first insulating area and the second area is designated outside the outer edge of the small wafer,

wherein a boundary between the second area and the second insulating area is designated inside the outer edge of a large wafer positioned in the center of the mounting face, and the second insulating area extends outward from the large wafer, and

wherein a cover member, which has a ring shape and which is detachable from the mounting face, is provided to completely cover the second area.

[Advantages Of The Invention]

[0008]

According to the present invention, the mounting face of the electrode member on which a wafer to be processed is positioned is divided into: the first area, which is formed like a circle,

concentric with the electrode member, and in which metal, the material used for the electrode member, is exposed; the first insulating area, the surface of which is covered with an insulating film, that encloses the outside of the first area like a ring; the second area, which extends, like a ring, outward from the first insulating film and in which the metal is exposed; the second insulating area, the surface of which is covered with an insulating film, that encloses, like a ring, the outside of the second area. Since the first and second insulating areas are arranged in accordance with the locations of the outer edges of a small wafer and a large wafer, the same plasma processing apparatus can easily and inexpensively process a plurality of wafers having different sizes.

[Modes for Carrying Out The Invention]

[0009]

Fig. 1 is a side cross-sectional view of a plasma processing apparatus according to a first embodiment of the present invention. Fig. 2 is a side cross-sectional view of the vacuum chamber of the plasma processing apparatus according to the first embodiment. Fig. 3 is a cross-sectional view of the electrode member of the plasma processing apparatus according to the first embodiment. Fig. 4 is a plan view of the electrode member of the plasma processing apparatus according to the first embodiment. Fig. 5 is a cross-sectional view of part of the electrode member of the plasma processing apparatus according to the first embodiment. Figs. 6 and 8 are perspective views of the electrode member of the plasma processing apparatus according to the first embodiment. Figs. 7 and 9 are cross-sectional views of parts of the electrode member of the plasma processing apparatus according to the first embodiment. Fig. 10 is a perspective view of the electrode member of a plasma processing apparatus according to an embodiment of the invention.

[0010]

First, the configuration of the plasma processing apparatus will be described while referring to Figs. 1 and 2. The plasma processing apparatus performs a plasma process for the reverse face of a wafer whereon an insulating sheet is adhered to the obverse face. In this embodiment, a plurality of wafers, including, at the least, a large wafer and a small wafer, are to be processed.

[0011]

In Fig. 1, a vacuum chamber 1 is a container with a lid member 1a that can be opened and closed by a hinge mechanism 5 (see Fig. 2) at the top. A lock cylinder 7 is located at the end of the upper face of the lid member 1a, and when the lid member 1a is closed, a rod 7a is fitted into an

engagement portion 1d that is fixed to the side face of the vacuum chamber 1, so that the lid member 1a is locked and provides a closed space.

[0012]

By closing the lid member 1a, the closed space is defined in the vacuum chamber 1 and is used as a process chamber 2 wherein plasma is generated under reduced pressure to perform a plasma process. An opening 1b, fitted with a door member 8, is arranged on the side face of the vacuum chamber 1. The opening 1b is exposed or blocked by raising or lowering the door member 8, and when exposed, a process object can be inserted into or removed from the process chamber 2. Further, as is shown in Fig. 2, when the lid member 1a is pivoted upward by the hinge mechanism 5, the process chamber 2 is open from above, so that, as is described later, the replacement of a stage, when a wafer having a different size is employed, and internal maintenance can be easily performed.

[0013]

In the process chamber 2, a first electrode 3 and a second electrode 4 are vertically arranged, facing each other, so that the second electrode 4, relative to the first electrode 3, is an opposed electrode. The first electrode 3 and the second electrode 4 are cylindrically shaped, and are concentrically positioned in the process chamber 2. The first electrode 3 is made of a conductive metal, such as aluminum, and is so designed that a support portion 3c extends downward from a disk-shaped main body, to which an electrode portion (electrode member) 3a is attached. The support portion 3c is held in the vacuum chamber 1 by an insulating member, so that in the vacuum chamber 1, the support portion 3c is electrically insulated. A wafer 6 to be processed (see either wafer 6A or 6B in Fig. 5) is positioned on the electrode portion 3a.

[0014]

The second electrode 4, as well as the first electrode 3, is made of a conductive metal, such as aluminum, and has a support portion 4b that extends upward from a disk-shaped electrode portion 4a. The support portion 4b is so held that it is electrically conductive in the vacuum chamber 1, and when the lid member 1a is closed, a discharge space 2a for plasma generation is defined between an electrode portion 4a and the electrode portion 3a of the first electrode 3 located below.

[0015]

A vacuum pumping unit 11 is connected to an air release port 1c that communicates with the process chamber 2. When the vacuum pumping unit 11 is driven, air inside the process

chamber 2 of the vacuum chamber 1 is evacuated, and the pressure in the process chamber 2 is reduced. The vacuum pumping unit 11 serves as pressure reduction means for evacuating gas, through the air release port 1c, from the process chamber 2, a closed space, and for reducing the pressure therein.

[0016]

The first electrode 3 is electrically connected to a high frequency power source 16. Thus, when the high frequency power source 16 is driven, a high frequency voltage is applied between the second electrode 4 and the first electrode 3, which are conductive in the vacuum chamber 1 that is grounded. As a result, a plasma discharge occurs in the process chamber 2. The high frequency power source 16 serves as plasma generation means for applying a high frequency voltage between the first electrode 3 and the second electrode 4, and for changing a plasma generation gas to the plasma state.

[0017]

Further, a DC power source (direct-current power source) 12 for electrostatic attraction is connected to the first electrode 3 through an RF filter 13. When the DC power source 12 for electrostatic attraction is driven, a negative charge is accumulated on the surface of the first electrode 3. In this state, when the high frequency power source 16 is driven to generate plasma in the process chamber 2, a positive charge is accumulated on a wafer 6.

[0018]

Then, Coulomb forces, acting between the negative charge accumulated on the first electrode 3 and the positive charge accumulated on the wafer 6, hold the wafer 6 to the first electrode 3 through an insulating sheet 6a, which is a dielectric member. At this time, the RF filter 13 prevents the high frequency power source 16 from applying a high frequency voltage directly to the DC power source 12 for electrostatic attraction. The DC power source 12 for electrostatic attraction serves as DC voltage application means for applying a DC voltage to the electrode member 3a of the first electrode 3 to electrostatically attract a wafer 6 positioned on a mounting face 3b.

[0019]

The detailed structure of the second electrode 4 will now be described. Gas propulsion holes 4d are formed in the center of the lower face of the second electrode 4. The gas propulsion

holes 4d communicate with a gas supply unit 17 through a gas supply hole 4c formed inside the support portion 4b. Since the gas propulsion holes 4d are covered with a porous plate 4e, a gas propelled through the gas propulsion holes 4d spreads through the porous plate 4e. When the gas supply unit 17 is driven, a plasma generation gas containing fluorine is passed through the gas propulsion holes 4d and the porous plate 4e and is supplied to the discharge space 2a. The gas supply unit 17 serves as gas supply means for supplying a plasma generation gas to the process chamber 2 wherein the pressure has been reduced.

[0020]

In the configuration shown in Fig. 1, the lock cylinder 7, the vacuum pumping unit 11, the DC power source 12 for electrostatic attraction, a vacuum pump 14, a cooling mechanism 15, the high frequency power source 16, and the gas supply unit 17 are controlled by a controller 10, and the plasma process is performed while control of these individual sections is exercised by the controller 10.

[0021]

An explanation will now be given for a wafer 6 to be processed by the plasma processing apparatus. The wafer 6 is a semiconductor substrate, and a logic circuit is formed on its obverse surface. The face opposite the circuit formation face is ground by a machine, and thereafter, a plasma process, using etching, is performed for this reverse face of the semiconductor substrate to remove micro-cracks that are caused by the machining.

[0022]

The insulating sheet 6a is adhered to the circuit formation portion of the obverse face (the lower side in Figs. 5, 7 and 9) of the wafer 6. And during the plasma process, the insulating sheet 6a is brought into contact with the mounting face 3b, which is the upper face of the first electrode 3, so that the wafer 6 is positioned with the mechanically ground face facing upward. The insulating sheet 6a, a resin sheet whereon a film, about 100 μm thick, composed of an insulating resin such as polyolefin, polyimide or poly(ethylene terephthalate) has been deposited, is adhered to the circuit formation face of the wafer 6 using a pressure sensitive adhesive. The insulating sheet 6a adhered to the wafer 6 protects the circuit formation face of the wafer 6, and also functions as a dielectric member for the electrostatical attraction the wafer 6, as will be described later.

[0023]

As is described above, the plasma processing apparatus of this embodiment processes wafers 6A and 6B having a plurality of sizes (in this embodiment, two sizes are processed: large (12 inches) and small (8 inches)), and performs the plasma process for either of these wafers that has been positioned on the common electrode member 3a. Therefore, the mounting face 3b, which is the upper face of the electrode member 3a, is larger than a large wafer 6A so that, of the plurality of wafers, a large wafer 6A can be positioned. To process a small wafer 6B, a separately provided cover member is used to cover the portion of the mounting face 3b that is exposed, so that the exposed portion will not be damaged by plasma during the process performed for the smaller wafer.
[0024]

While referring to Figs. 3, 4 and 5, an explanation will now be given for the detailed structure of the first electrode 3 to which is attached the electrode member 3a, which can be used in common for the two sizes represented by wafers 6A and 6B, as is described above. A cross section of the first electrode 3 is shown in Fig. 3. For the first electrode 3, a circular recessed portion 20a is formed in the upper face of a base 20 that is shaped substantially like a disk, and the electrode member 3a is integrally formed and fitted into the recessed portion 20a, while an outer ring member 22 is fitted around the outer edge of the base 20.
[0025]

Multiple suction holes 3e, formed in the upper face of the electrode portion 3a, open upward, toward the mounting face 3b. The suction holes 3e communicate through an internal hole 3d, which is formed horizontally inside the electrode member 3a, with a suction hole 3g that opens downward, toward the lower end of the support portion 3c. As is shown in Fig. 1, the suction hole 3g communicates with the vacuum pump 14, and when the vacuum pump 14 is driven, a vacuum is created and suction is produced that, through the suction holes 3e, draws down a wafer 6, positioned on the mounting face 3b, and holds it against the mounting face 3b. The vacuum pump 14 is vacuum creation means for producing suction that, through the suction holes 3e, draws down and holds a wafer 6 on the mounting face 3b. A sealing member 23 is provided at the face whereat the electrode member 3a and the base 20 contact each other, so that while the vacuum produced suction is applied, an airtight seal is ensured.
[0026]

A plurality of circumferential grooves and a plurality of diametrical grooves are formed in

the lower face of the electrode portion 3a. When the electrode member 3a is assembled in the recessed portion 20a, these grooves serve as coolant flow paths 3f for cooling the electrode member 3a. The ends of the coolant flow paths 3f open towards the lower end of the support portion 3c, and as is shown in Fig. 1, are connected to the cooling mechanism 15. When the cooling mechanism 15 is driven, a coolant such as cooling water circulates along the coolant flow paths 3f, so that the electrode member 3a, the temperature of which is increased by heat generated during the plasma process, and the insulating sheet 6a of a wafer 6, which is positioned on the electrode member 3a, are cooled. The coolant flow paths 3f and the cooling mechanism 15 constitute cooling means for cooling the electrode member 3a. A sealing member 24 is attached to the face where the electrode member 3a and the base 20 contact each other, so that while the coolant is circulating, a watertight seal is ensured.

[0027]

The mounting face 3b of the electrode member 3a will now be explained. The mounting face 3b of the electrode member 3a is divided into a plurality of segments along the concentric boundaries. Specifically, as is shown in Fig. 4, a first area 31, which is a circular segment, is concentrically arranged with the electrode member 3a in the center of the mounting face 3b. A conductive metal, the material that is used for the electrode member 3a, is exposed in the surface of the first area 31, in which suction holes 3e are formed. A first, ring-shaped insulating area 31a, which is covered with an insulating film 27 that is formed of aluminous ceramic (see Figs. 3 and 5), encloses the outside edge of the first area 31.

[0028]

Further, a second area 32, a ring-shaped segment, is located outside the first insulating area 31a. And just as in the first area 31, a conductive metal, the material that is used for the electrode 3a, is exposed in the surface of the second area 32, in which suction holes 3e are also formed. Furthermore, a second, ring-shaped insulating area 32a, which is covered with an insulating film 26 that is also formed of aluminous ceramic (see Figs. 3 and 6), encloses the outside edge of the second area 32.

[0029]

While referring to Fig. 5, an explanation will be given for the relationship existing between the insulating areas of the thus defined segments of the mounting face 3b, i.e., the portions of the

mounting face 3b that are covered with the insulating films 26 and 27, and the sizes of the wafers 6. The insulating areas are provided to protect the metal, which is the conductive portion of the electrode member 3a, from direct exposure to plasma in the discharge area 2a. In Fig. 5 is shown the relationship between the positions of the insulating films 26 and 27 and the positions of the outer edges of large and small wafers 6A and 6B that are positioned in the center of the mounting face 3b.

[0030]

When a wafer 6A is to be positioned, a ring member 29 is attached to an outer ring member 22. The ring member 29 is used to introduce and guide a wafer 6A and to prevent the positional shifting of the wafer 6A relative to the mounting face 3b. To position a wafer 6B, a detachable cover member 25 is attached to the mounting face 3b. The cover member 25 is also used to introduce and guide a wafer 6B and to prevent the positional shifting of the wafer 6B. The function of the cover member 25 will be described later.

[0031]

First, the positional relationship between a wafer 6B and the first insulating area 31a will be explained. As is shown in Fig. 5, a boundary C1 (see Fig. 4), between the first area 31 and the first insulating area 31a, is located inside the outer edge of a wafer 6B that is positioned in the center of the mounting face 3b, and is completely hidden by the wafer 6B. A boundary C2 (see Fig. 4) between the first insulating area 31a and the second area 32 is located outside the outer edge of the wafer 6B, so that it is not hidden by the wafer 6B.

[0032]

Furthermore, a boundary C3 (see Fig. 4) between the second area 32 and the second insulating area 32a is located inside the outer edge of a wafer 6A that is positioned in the center of the mounting face 3b, and is completely hidden by the wafer 6A. An outer edge boundary C4 (see Fig. 4) of the second insulating area 32a is located outside the outer edge of the wafer 6A, so that it is not hidden by the wafer 6A.

[0033]

The cover member 25 will now be descried. The cover member 25 (see Fig. 8) is made of ceramic and is shaped like a ring, so that when it is attached to the mounting face 3b, from above, it completely covers the second area 32 (the range extending from the boundary C2 to the boundary C3). The cover member 25 is provided for the mounting face 3b when a wafer 6B is to be

processed, or is removed from the mounting face 3b when a wafer 6A is to be processed.

[0034]

To attach the cover member 25 to the mounting face 3b, a ring-shaped blocking member 9 is placed on the second area 32 of the mounting face 3b. The blocking member 9 is a dummy wafer to which an insulating sheet 9a, which is made of the same material as the insulating sheet 6a adhered to wafers 6A and 6B, is adhered to one face (the lower face in Fig. 5) of a ring plate that is made of the same silicon as wafers 6A and 6B. The blocking member 9 may be a resin plate made, for example, of glass epoxy or poly(ethylene terephthalate).

[0035]

Since the blocking member 9 is attached, during the vacuum suction process performed using the suction holes 3e, the blocking member 9 closely contacts the mounting face 3b and blocks the suction holes 3e formed in the second area 32. Therefore, vacuum produced suction is applied to a wafer 6B only through the suction holes 3e formed in the first area 31, which is the suction range required for a wafer 6B. Further, from above, the thus provided blocking member 9 is completely hidden by the cover member 25. Thus, the blocking member 9 can be protected from exposure to plasma, and wearing of the part can be prevented.

[0036]

In this embodiment, the outer diameter of the cover member 25 is equal to the outer diameter of the ring member 29 (see Fig. 5). However, the outer diameters of these members may differ. With this arrangement, a difference in the outer diameters can be detected by an optical sensor, and whether the cover member 25 is attached to the electrode member 3a can be automatically determined.

[0037]

The plasma process will now be described. When a wafer 6A is employed, as is shown in Fig. 6, in a preparation process, the ring member 29 is attached to the electrode member 3a. This process is performed while the process chamber 2 is open, as is shown in Fig. 2. After this process has been completed and the process chamber 2 has been closed, the plasma process is started, and a wafer 6A is attached to the electrode member 3a. In the state wherein the wafer 6A is positioned, as is shown in Fig. 7, the outer edge of the wafer 6A rests on the insulating film 26, and the boundary C3 between the insulating film and the second area 32 is completely hidden.

[0038]

When a wafer 6B is employed in the preparation process, as is shown in Fig. 8, the blocking member 9 is attached to the electrode member 3a and the cover member 25 is attached to cover the blocking member 9. When this process has been completed and the process chamber 2 has been closed, the plasma process is initiated, and the wafer 6B is attached to the electrode member 3a. In the state wherein the wafer 6B has been mounted, as is shown in Fig. 9, the outer edge of the wafer 6B rests on the insulating film 27, and the boundary C1 between the insulating film 27 and the first area 31 is completely hidden by the wafer 6B.

[0039]

During the stage replacement process performed when wafers are changed, as is shown in Fig. 2, the ring member 29 and the cover member 25 can be replaced efficiently while the process chamber 2 is open. Further, since the electrode member 3a is integrally formed, the stage replacement process can be performed while the coolant flow paths 3f for cooling an electrode member are completely closed, so that the inside of the process chamber 2 can be prevented from being damaged due to the leakage of coolant.

[0040]

When either a wafer 6A or a wafer 6B has been positioned on the mounting face 3b, the process chamber 2 is closed and the plasma process is begun. During the plasma process, first, the vacuum pump 14 is driven, creating a vacuum and producing suction that, through the suction holes 3e and 3g, draws the wafer 6A or 6B down and holds it so that it closely contacts the mounting face 3b.

[0041]

Then, the vacuum pumping unit 11 is driven to create a vacuum and evacuate air from the process chamber 2, and the gas supply unit 17 supplies a plasma generation gas to the process chamber 2. Thereafter, the DC power source 12 for electrostatic attraction is driven to apply a DC voltage, and the high frequency power source 16 is driven to start plasma discharge. Through this process, plasma is generated in the discharge space 2a to perform the plasma process for the wafer 6A or 6B. During this plasma process, an electrostatic attraction force is generated between the electrode member 3a and the wafer 6A or 6B, so that the wafer 6A or 6B is held to the electrode member 3a by the electrostatic attraction force.

[0042]

During the electrostatic attraction process, the center of the insulating sheet 6 is brought into contact with the center of the electrode member 3a, and the outer edge of the insulating sheet 6a is brought into contact with the insulating film 26 or 27. Then, mainly the center portion of the insulating sheet 6a is employed as a dielectric member for the performance of the electrostatic attraction process, and the wafer 6A or 6B, at the center of the upper face, is electrostatically attracted while the outer edge of the insulating sheet 6a is brought into close contact with the insulating film 26 or 27. As a result, the conductive portion of the electrode member 3a is insulated from the plasma. And therefore, efficient electrostatic attraction can be obtained without the charge employed for electrostatic attraction leaking to the plasma side.

[0043]

During the plasma process, regardless of which of the wafers 6A and 6B is employed, the first area 31 and the second area 32, which are the conductive portions forming the surface of the electrode member 3a, are completely insulated from plasma generated in the discharge space 2a. Therefore, an abnormal plasma discharge can be prevented, and the operating state of the plasma processing apparatus can be stabilized.

[0044]

While large and small wafers 6A and 6B are employed in the above-embodiments, the present invention is not limited to these two, and other wafers having different sizes may be employed. For example, as is shown in Fig. 10, when a wafer 6C that is smaller than a wafer 6B is also to be processed, an insulating area, which is covered with an insulating film 28, as are the insulating films 26 and 27, is additionally positioned on a mounting face 3b at a position corresponding to the outer circumference of the wafer 6C. Further, a cover member 25A, consonant with the size of the wafer 6C, is prepared. In this case, the wafer 6C, as well as the wafer 6B, is smaller than the wafer 6A.

[Industrial Applicability]

[0045]

According to the present invention, a single plasma processing apparatus can easily and inexpensively handle a plurality of wafers having different sizes. Therefore, the present invention can effectively be employed for a plasma processing apparatus provided for the performance of a

wafer etching process using plasma.

[Brief Description Of The Drawings]

[0046]

[Fig. 1]

Fig. 1 is a side cross-sectional view of a plasma processing apparatus according to a first embodiment of the present invention.

[Fig. 2]

Fig. 2 is a side cross-sectional view of the vacuum chamber of the plasma processing apparatus according to the first embodiment.

[Fig. 3]

Fig. 3 is a cross-sectional view of the electrode member of the plasma processing apparatus according to the first embodiment.

[Fig. 4]

Fig. 4 is a plan view of the electrode member of the plasma processing apparatus according to the first embodiment.

[Fig. 5]

Fig. 5 is a cross-sectional view of part of the electrode member of the plasma processing apparatus according to the first embodiment.

[Fig. 6]

Fig. 6 is a perspective view of the electrode member of the plasma processing apparatus according to the first embodiment.

[Fig. 7]

Fig. 7 is a cross-sectional view of part of the electrode member of the plasma processing apparatus according to the first embodiment.

[Fig. 8]

Fig. 8 is a perspective view of the electrode member of the plasma processing apparatus according to the first embodiment.

[Fig. 9]

Fig. 9 is a cross-sectional view of part of the electrode member of the plasma processing apparatus according to the first embodiment.

[Fig. 10]

Fig. 10 is a perspective view of the electrode member of a plasma processing apparatus according to a fifth embodiment of the invention.

[Description Of The Reference Numerals And Signs]

[0047]

1: vacuum chamber

2: process chamber

3: first electrode

3a: electrode member

3b: mounting face

3e: suction hole

4: second electrode

6A, 6B, 6C: wafer

6a: insulating sheet

10: controller

11: vacuum pumping unit

12: DC power source for electrostatic attraction

14: vacuum pump

16: high frequency power source

17: gas supply unit

25, 125, 225, 325: cover member

26, 27: insulating film

31: first area

31a: first insulating area

32: second area

32a: second insulating area

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[Fig. 1]

1: vacuum chamber

2: process chamber

3: first electrode

3a: electrode member

3b: mounting face

4: second electrode

10: controller

11: vacuum pumping unit

12: DC power source for electrostatic attraction

14: vacuum pump

16: high frequency power source

17: gas supply unit

[Fig. 3]

3e: suction hole

26, 27: insulating film

[Fig. 4]

31: first area

31a: first insulating area

32: second area

32a: second insulating area

[Fig. 5]

6A, 6B: wafer

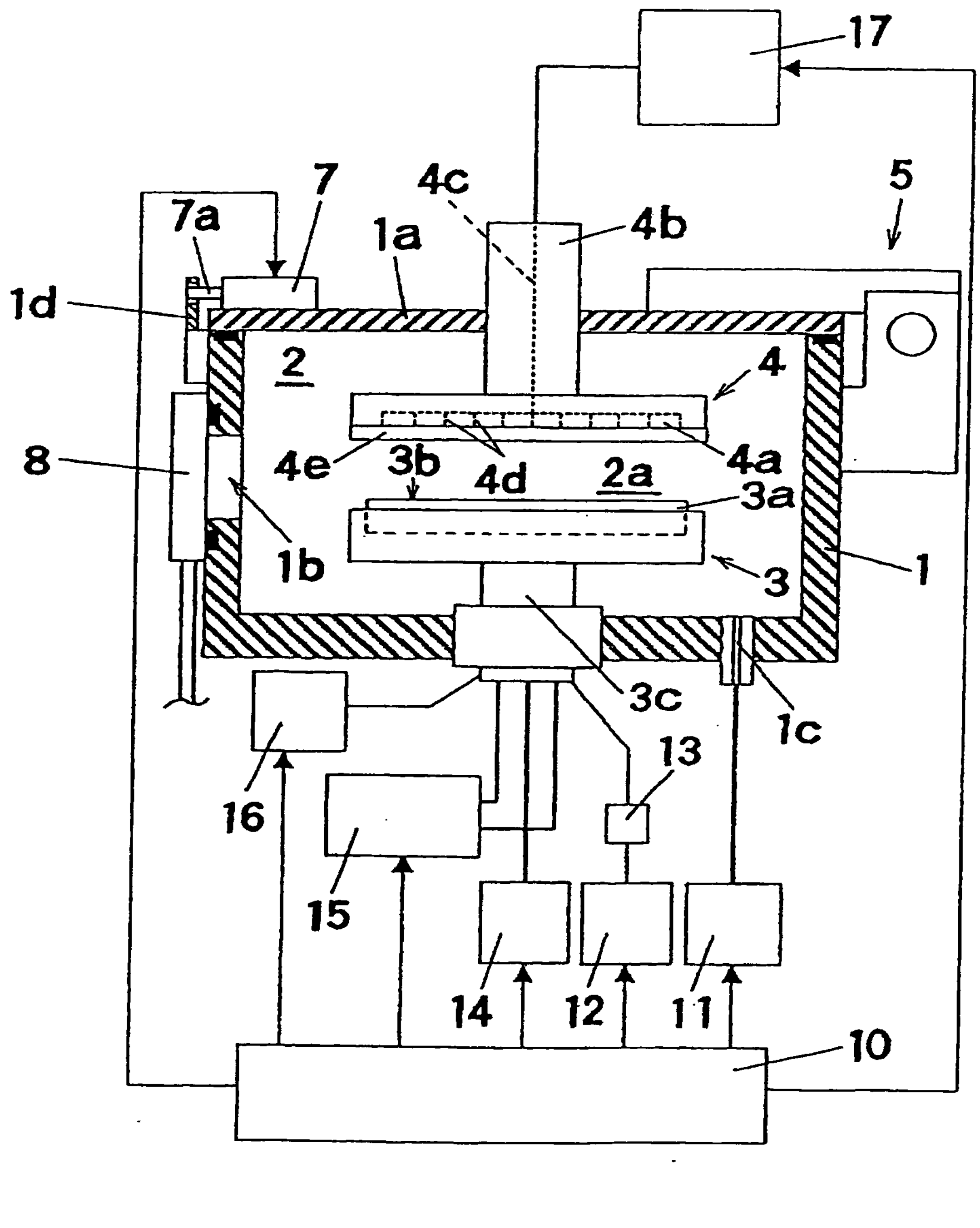
6a: insulating sheet

25: cover member

[Fig. 10]

6c: wafer

FIG. 1


17
5
7
7a
4c
4b
1a
1d
2
4
8
4e
3b
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14
12
11
10

FIG. 2

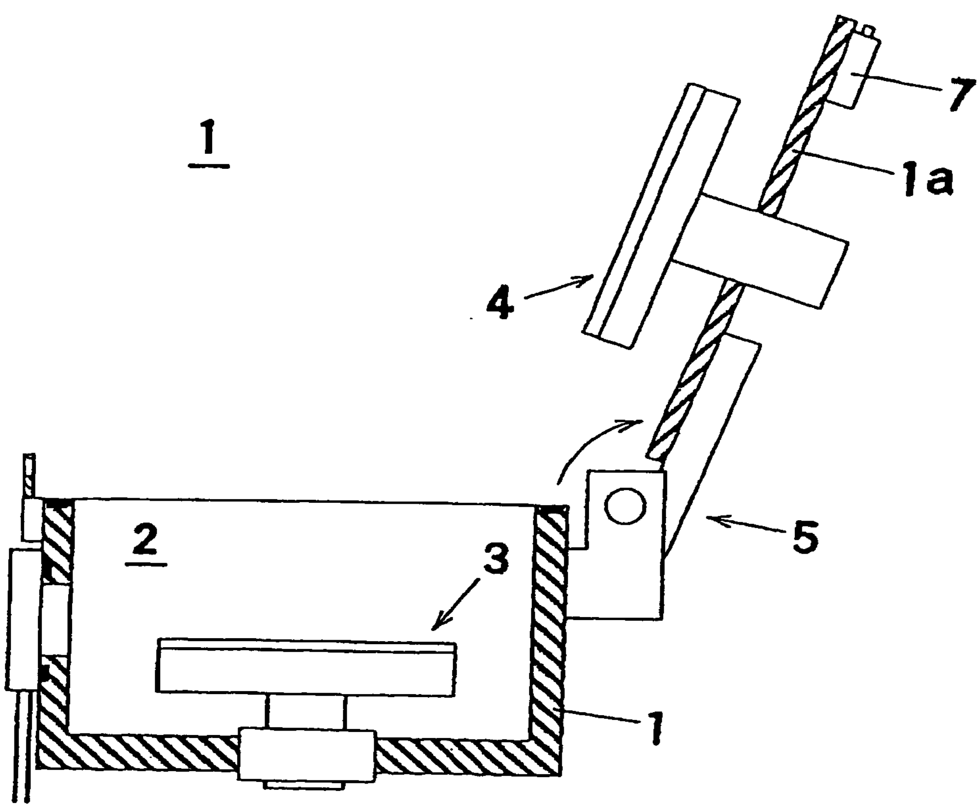


FIG. 3

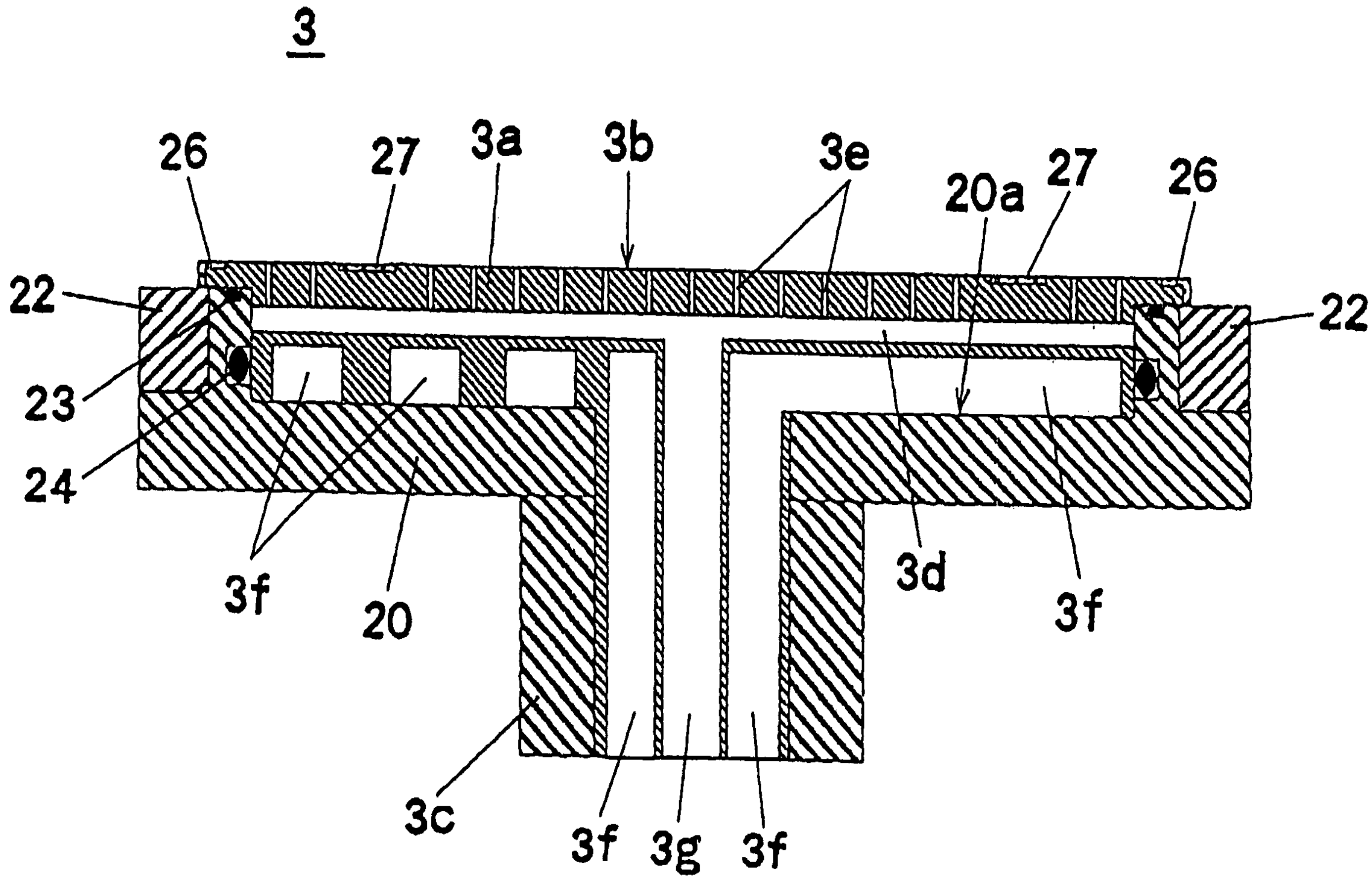


FIG. 4

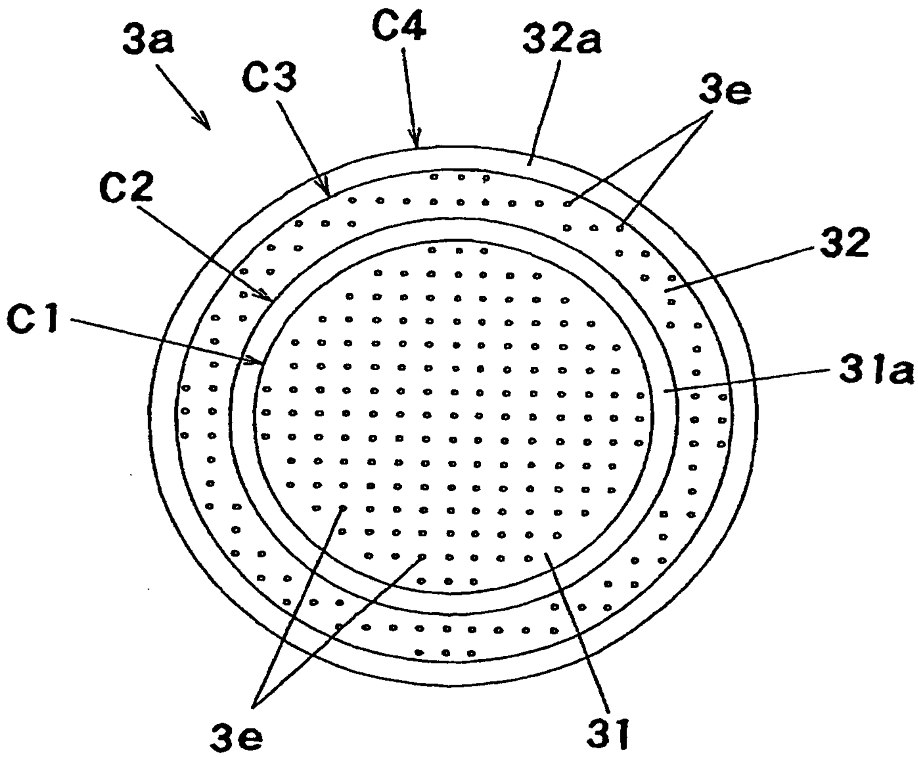


FIG. 5

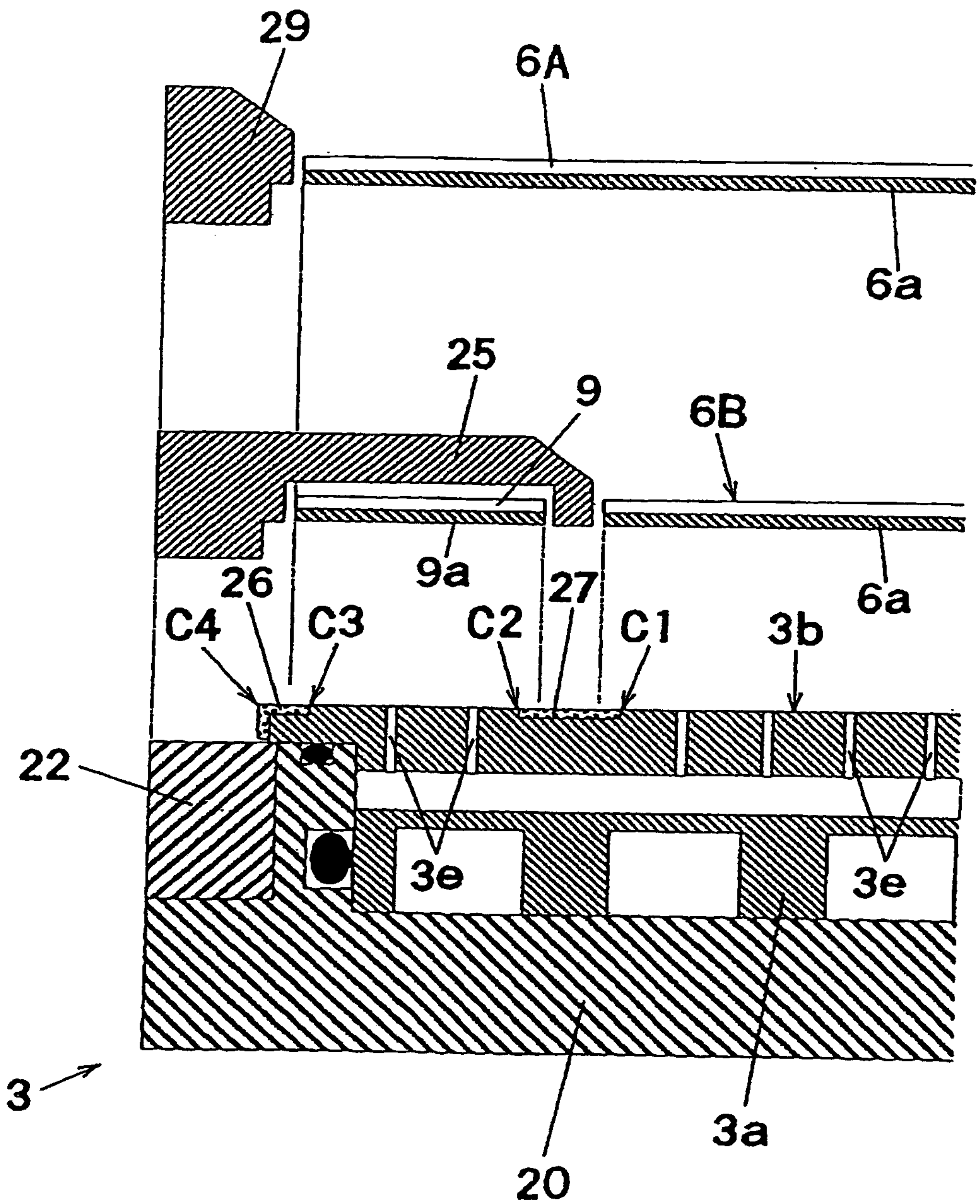
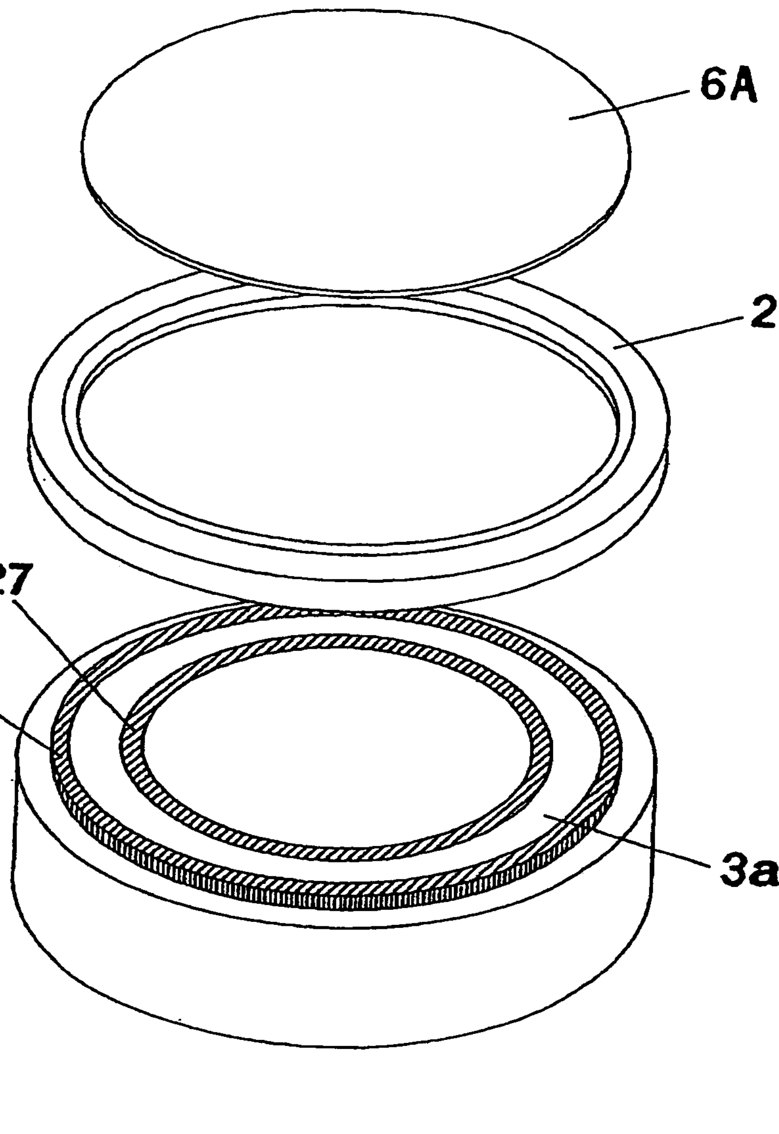


FIG. 6



[Fig. 7]

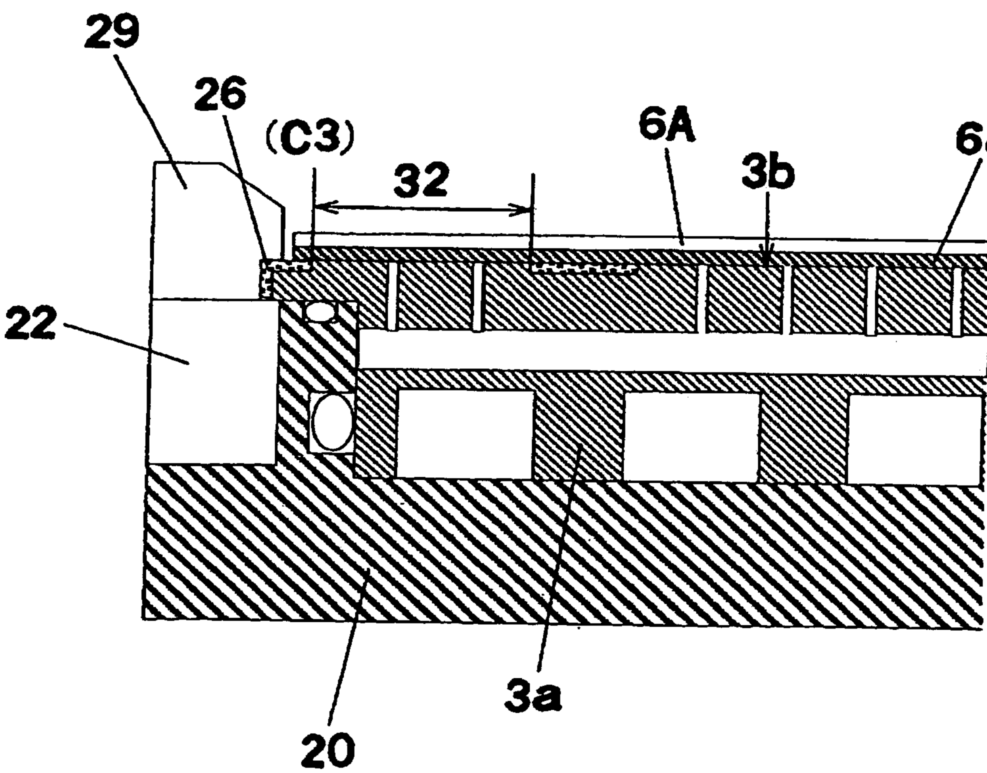
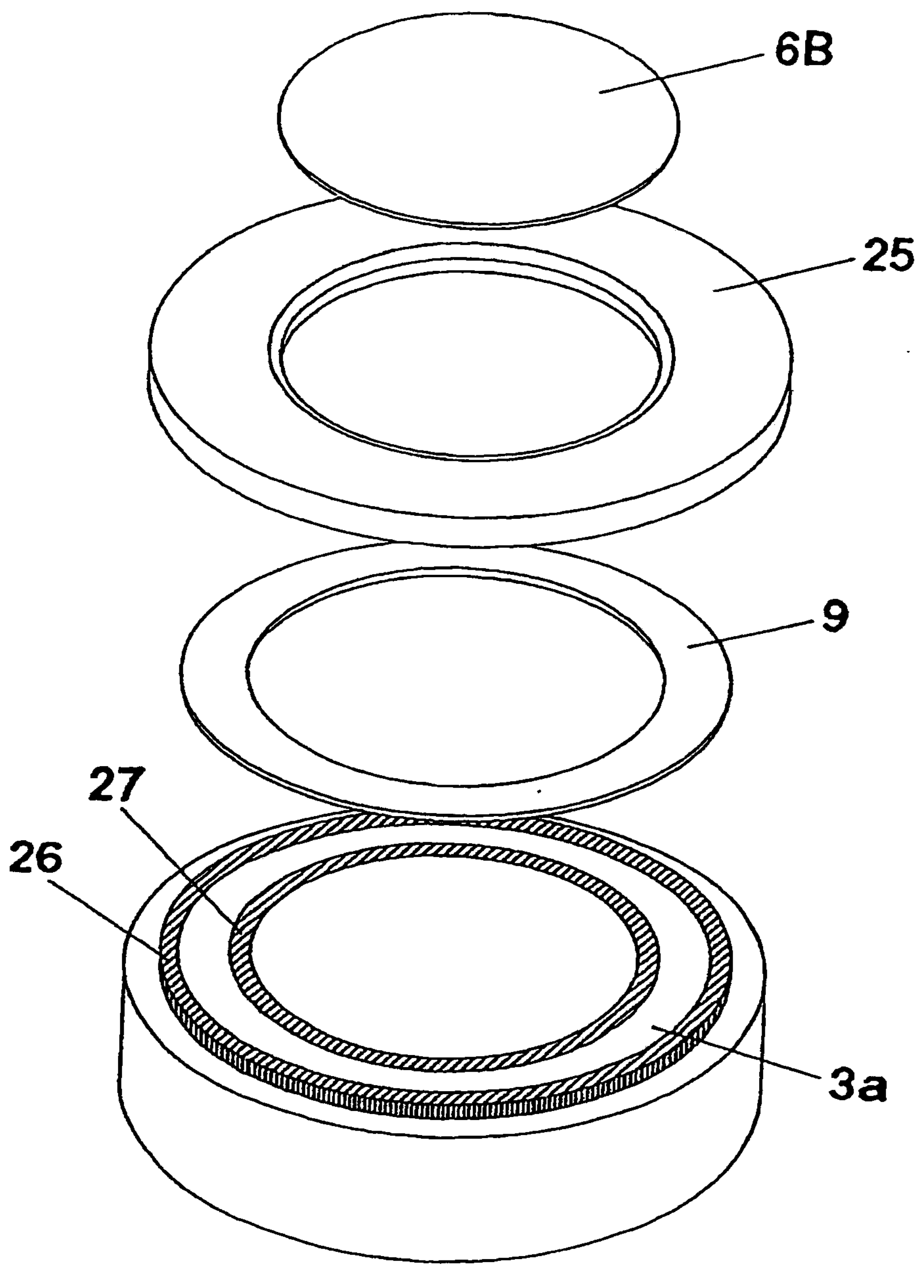


FIG. 8



[Fig. 9]

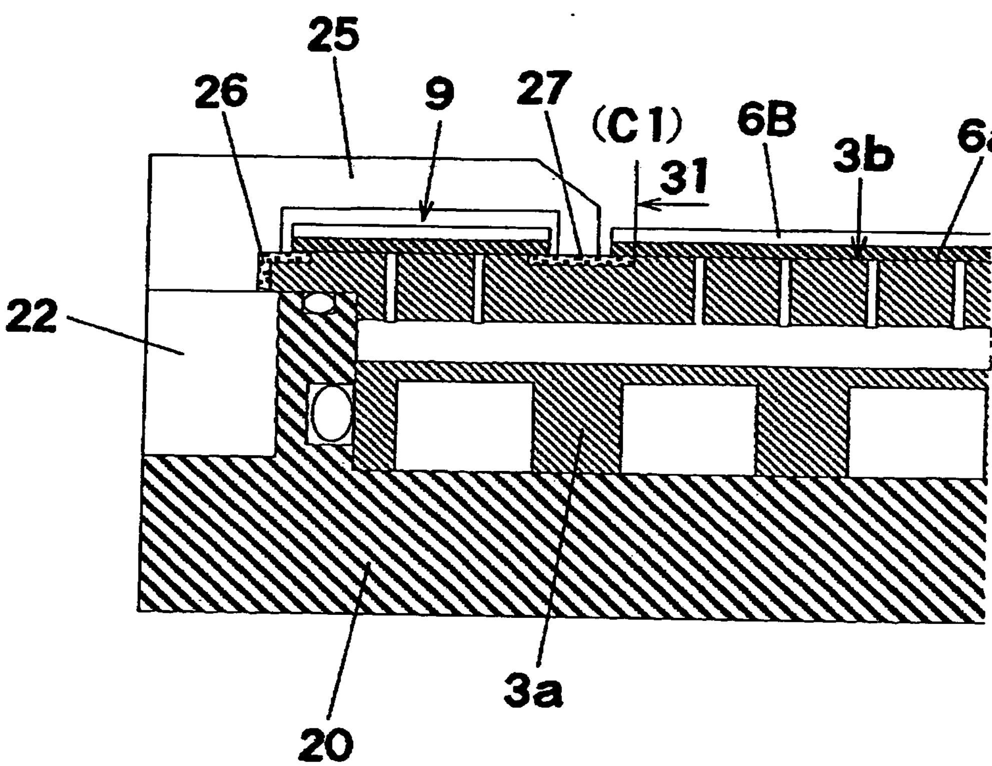
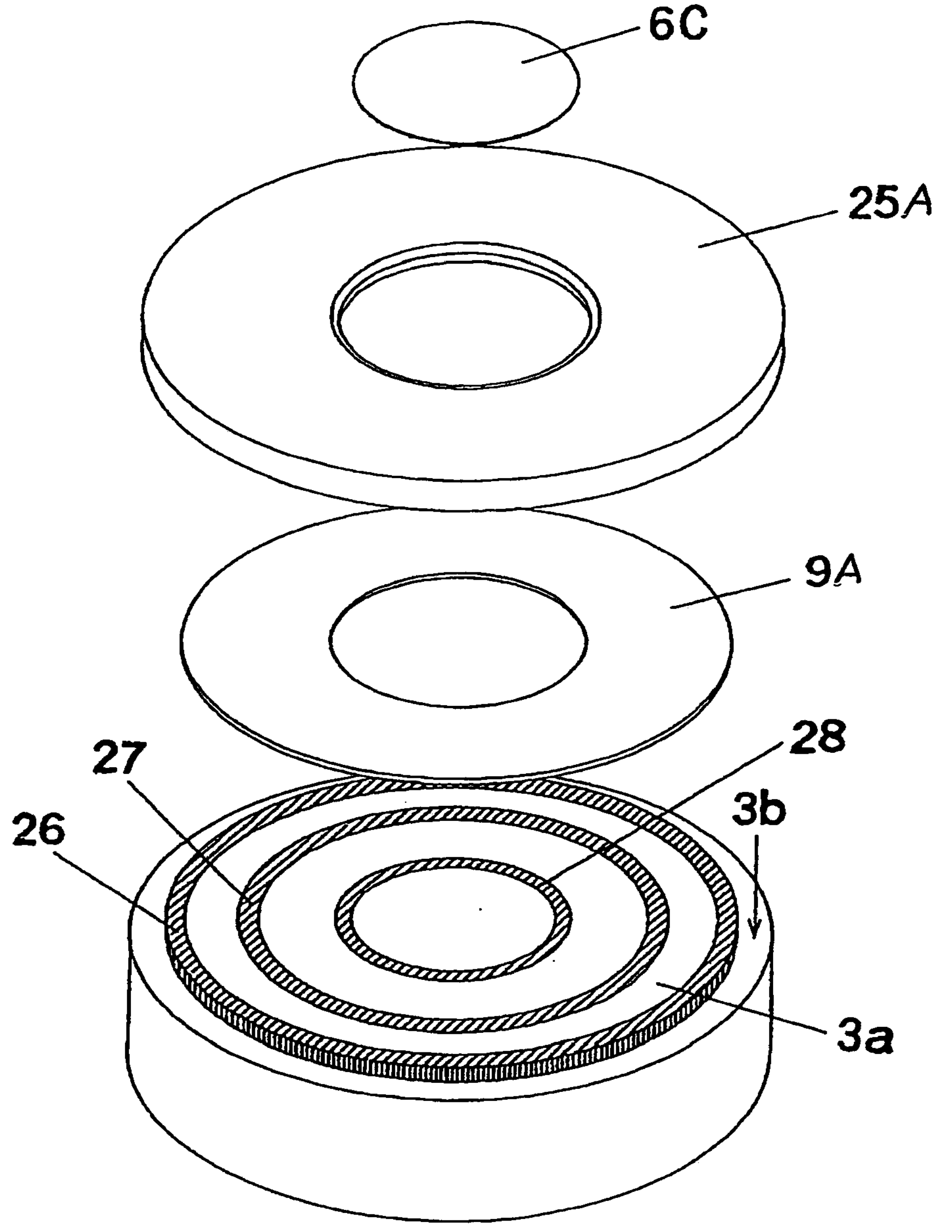


FIG. 10



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[Designation of Document] Abstract

[Abstract]

[Problem]

It is one objective of the present invention to provide a plasma processing apparatus, a single unit, that can easily and inexpensively handle a plurality of wafers having different sizes.

[Means for Resolution]

For a plasma processing apparatus that performs an etching process for the face of a wafer opposite the circuit formation face, ceramic insulating films having a ring shape are positioned on the mounting face of an electrode member in consonance with the location of a large wafer or a small wafer. When a large wafer is employed, a ring member is attached. And when a small wafer is employed, a blocking member is mounted to hide a gap between the insulating films deposited on the mounting face 3b and to cover suction holes. Further, a cover member is attached to cover the blocking member from the top. With this arrangement, the plasma process can be performed, using the same electrode member, for wafers having different sizes.

[Selected Drawing] Fig. 5